numerous scientific journals of to-day. We look forward to the time when the *Annual Record of Science* will become a standard work absolutely indispensable to all libraries, both public and private, at home and abroad.

W. F. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Heat of the Comstock Mine

I NOTICE in NATURE, vol. xx. p. 168, that Dr. Lesley quotes from Prof. Barker an opinion in regard to the heat of the Comstock Mines in Nevada. Referring to my assertion that the heat of the rock "is pretty uniform" in the lower levels, Prof. Barker announces that there are "the most remarkable differences, some of the higher levels being much hotter than some of the lower levels." This is perfectly true, and the fact is no disproof of my assertion. In the article to which Dr. Lesley refers (*Silliman's Journal*, April, 1879) I said that there are striking differences of temperature in the rock, and endeavoured to explain them by showing that there is a great mass of rock which may be regarded as heated to a tolerably uniform degree at all points in the length of the lode, on any given level, and that in this general mass there are isolated localities, most of which show a temperature above that of the rock at large, but some of them below it. I pointed out the conditions under which these local maxima occur, and gave the explanation to which I thought they led. The hot spots are evidently narrow and long, and as the mine openings sometimes intersect and sometimes follow them for some distance, a given level will be for a part of its length in a hot belt and for a part in the general mass of heated rock, or one level may be in a hot belt and show a much higher temperature than the level below, which entirely escapes the exceptionally hot ground. In this way thermometric variations are obtained between different levels and between different parts of the same levels, and these facts were all brought out in my article.

I should not trouble you with this explanation did I not feel that the Comstock lode bids fair to become a classic field for the discussion of terrestrial temperatures. Mr. Clarence King is now on the ground, and will, no doubt, make its unrivalled heat phenomena the subject of careful examination, and everything that bears upon the question has importance.

Dr. Lesley expresses some doubt upon the mechanical theory of earth-heat which was one of Prof. Barker's two conclusions upon the source of the heat. The Comstock is certainly good ground to test this question, for I have never witnessed such constant and general movement of the rocks in any other mines. Still, I do not share Prof. Barker's opinion on this, or on his other point, "that the heat is a hot-water heat." No mining engineer would pronounce the Comstock a wet lode. It discharges four and a half million tons of water yearly, and yet out of the more than twelve miles of linear excavation made every year, I do not believe that 1,000 feet are in ordinarily wet ground. It is a dry lode for the greater part, and in writing upon the subject my efforts have been directed to seeking an explanation for the extraordinary temperature of this dry rock.

JOHN A. CHURCH

115, Broadway, New York, September 8

Crossley's Modification of Hughes's Microphone

EVER since Hughes's discovery of those principles which led to his invention of the microphone, inventors have been trying to improve the instrument by adopting every variety of form and employing every combination of apparatus that were likely to lead to good results. The failures must have been legion, and of the successes the members of the British Association have had during their stay at Sheffield, an opportunity of examining and seeing at work perhaps the most efficient—Crossley's modification of the microphone. Six distant places—the two newspaper offices and four meeting-rooms—were telegraphically connected with the Cutlers' Hall, where a switch-board stood to place any two distant stations into communication, thus illustrat-

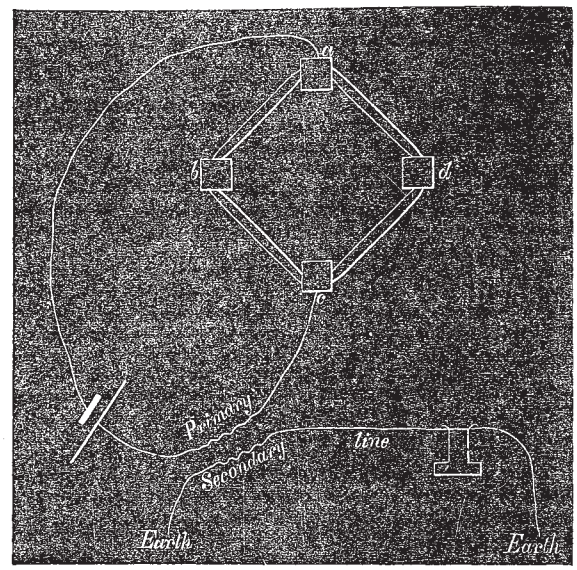

FIG. 1.

ing the exchange system so largely employed in America. Every one is aware that with the telephone the speaker has to hold the

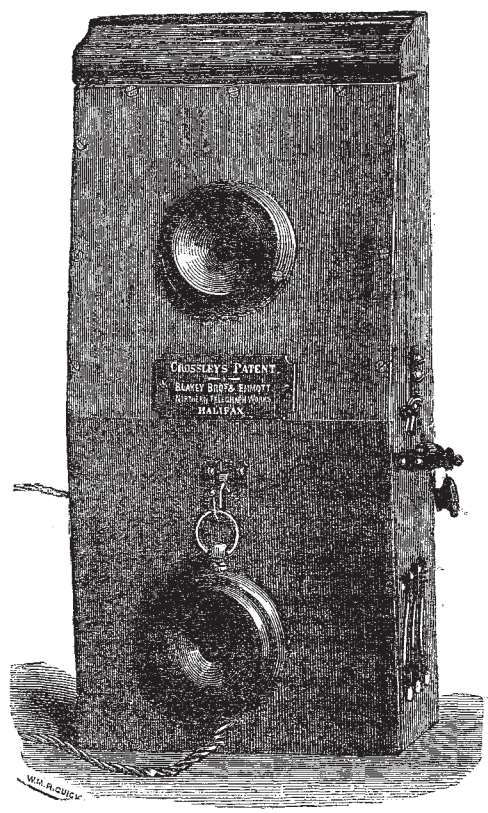

FIG. 2.

instrument to his mouth; with the Crossley's transmitter, however, conversation, a few feet away, is readily conveyed. The transmitter is now being largely employed in the United King-

dom, and it is found that where telephones alone are useless because of the induction of adjacent wires, the instrument acts admirably. The undulatory current produced by sonorous vibrations is so intense that a person speaking about a foot away from a transmitter has been heard ten feet from an ordinary telephone in Manchester thirty-six miles away by wire, and this although the induction from some thirty adjacent wires had to be overcome, and we may add that the intensity of the sound may be largely augmented by employing increased battery power.

Four carbon pencils are nicely centred and loosely held in four blocks of carbon, *a b c d*; two opposite blocks, *a* and *c*, are connected in circuit with a battery and the primary wire of an induction-coil. The efficiency of the arrangement is now made complete by having a telephone in the secondary circuit. The carbon blocks are mounted on a thin wooden diaphragm, and consequently are not seen in Fig. 3, which represents one form of the finished instrument.

For some months past an interesting and highly successful operation has been made every Sunday. One of these trans-

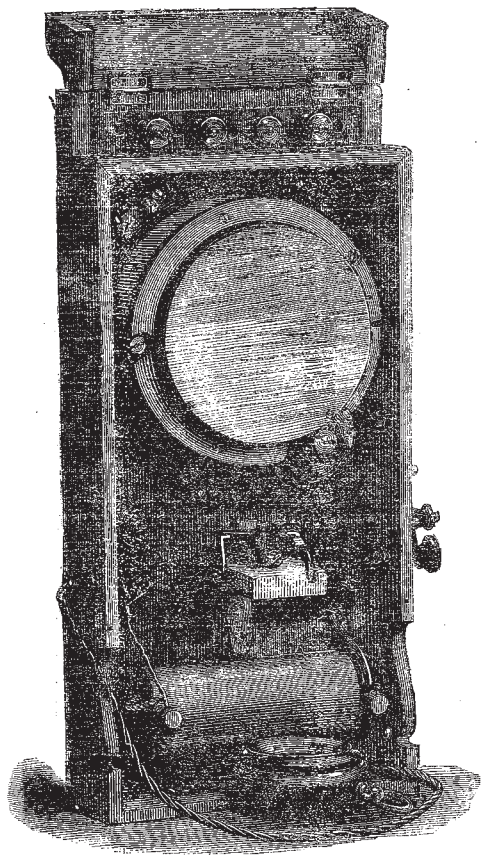

FIG. 3.

mitters is fixed in the pulpit of one of the Halifax places of worship. Its position is not over-favourable, being half hidden so as to escape attention, and thus to some extent its efficiency is interfered with. In the nether regions, where the organ-blowing apparatus is found, a Clamond's thermo-electric pile is placed, and one of the first duties of the sexton on a Sunday morning and evening is to light a gas jet under the pile. In this way a sufficient supply of electricity is obtained to work exceedingly well at a cost of less than 2*d.* per Sunday in gas consumed. On the outskirts of the town several houses have telephones in the secondary circuit, one of these belonging to an invalided lady, and the service, from the opening voluntary to the parting benediction, is heard plainly by every one. The rendering of the music is especially fine, sounding to the observer, sat at ease in an arm-chair, as if proceeding from a neighbouring room with the door slightly ajar.

WILLIAM ACKROYD

Colour-Blindness

WHEN your able reviewer Prof. Pole so plainly intimates, in NATURE, vol. xx. pp. 477 to 480, that he does not consider any of the theories of colour-blindness he has mentioned to be altogether sufficient for the observed facts, and that he may return to the subject in a future number, I trust he may then take some notice of my views, as honoured by the Royal Society, Edinburgh, in vol. xxviii. of their *Transactions*.

At all events, it is much to be hoped that in his own future descriptions, he will define his colours more accurately than by the naked eye estimations and names of even those who are allowed to possess normal vision. For, as I have shown in the paper above alluded to, there are physical distinctions, amounting to more than the oppositions of black and white, and reacting on colour, between many pigments generally reputed by the world to be all of the same colour to the eye.

To speak therefore of green, or red, or brown is nothing; but it is what green, and what red, and what brown that must be settled, as a preliminary to any further safe observation on the subject.

PIAZZI SMYTH

15, Royal Terrace, Edinburgh, September 19

The Carving of Valleys

IN the course of a recent visit to Loch Maree, I observed an interesting geological phenomenon in a glen on the east side of the loch, which is traversed in ascending Ben Slioch, from Kinlochewe, and which is called, I understand, Glen Beansdale. This glen, in its lower part at least, follows the line of division between the "fundamental gneiss," which rises in a gradual slope on the north side, and the "Cambrian sandstone," which on the south side forms a fine cliff, terminating at the base in a long steep "*débris* line." The stream, which is of considerable size, originally ran close to the foot of this cliff until it reached the wide valley which contains the loch; but at some period a large "bergfall" of rocks from the sandstone cliff has dammed up the original bed, and diverted the stream into a new course, diagonally across the gentle slopes of gneiss, which previously formed the north side of the glen. This new course is marked, first, by a small depression or gully in the flow of the glen, and secondly, in the middle of this, by a narrow ravine with vertical sides, just wide enough to contain the stream which foams at the bottom.

There is nothing in itself very remarkable about this diversion of a stream; but the point which gives the case its interest is that an inferior limit can be fixed for the time at which the diversion took place. For, on descending into the secondary depression above mentioned, I was able to trace the glaciation, or planing down by ice of the edges of the gneiss (which was admirably clear on these slopes) right down to the brink of the little ravine containing the stream, thus showing conclusively that the diversion had taken place *before* the glacial period, and so long before that the stream had time to cut a channel sufficient to guide the glacier in its flow, and divert it from the work it would otherwise have accomplished in clearing away the remains of the berg-fall, and re-opening the old river-course. Thus it will be seen that in the new channel we have an example of the work which can be done by a mountain stream during a period dating back at least beyond the glacial epoch; while the old channel exemplifies the work done in the same time by the various agencies of "sub-aërial waste"—rain, wind, frost, &c.—without a stream to assist them, either by direct erosion of its own or by sweeping away the *débris* which they had brought down.

What, then, are the phenomena presented by these two cases? In the first, the only work which can really be ascribed to the stream is the cutting of the deep narrow gorge at the bottom of which it now runs; for with regard to the wider depression above (itself a mere furrow in the main flow of the glen), it is impossible to say how much has been due to the planing action of the ice. In the second, the bottom of the old channel, if there be any power in "sub-aërial waste," should be choked by the *débris* which has come down from its sides, whereas I was easily able to detect live rock within a few feet of the tiny runnel which now drains the gully, and which itself picks its way among stones and boulders that are clearly nothing but the cumbered bed of the old-world torrent.

The question I wish to ask is whether the study of these two examples is not sufficient to produce something like a conviction that the modern school of geologists (as worthily represented by